Courtesy of Coscia Moos Architecture

Daylight Autonomy

made possible by Lutron

Reduce daytime lighting energy use by **65%**[1] **or more** through the use of automated shades.

LUTRON®

save energy with Lutron™

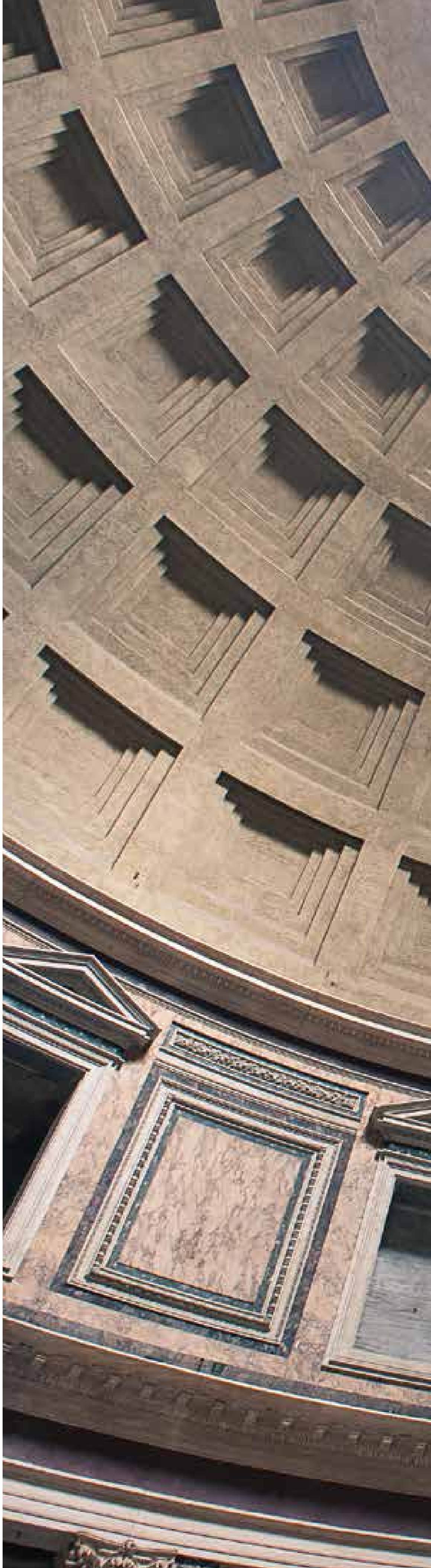
Daylight autonomy—a new term for an ancient practice

Before the introduction of electricity, buildings relied on daylight to illuminate interior spaces.

The Egyptians used daylight control to temper the heat of their extreme climate, introducing lattice and screens with different size openings to allow for daylight penetration into a space. In Rome, buildings were designed around courtyards surrounded by living space to maximize available daylight.

European Renaissance masters revered light as both a practical and aesthetic design tool. Baroque style used indirect light to create mystery and intrigue in buildings, but as electric lighting sources and technologies improved, daylight took a back seat in lighting design.

Today, encouraged by updated building codes, new energy regulations, and a renewed emphasis on sustainability, architects, building owners, and lighting designers are once again embracing daylight as a practical, aesthetic, and symbolic element of good building design. **This is known as designing for daylight autonomy**.



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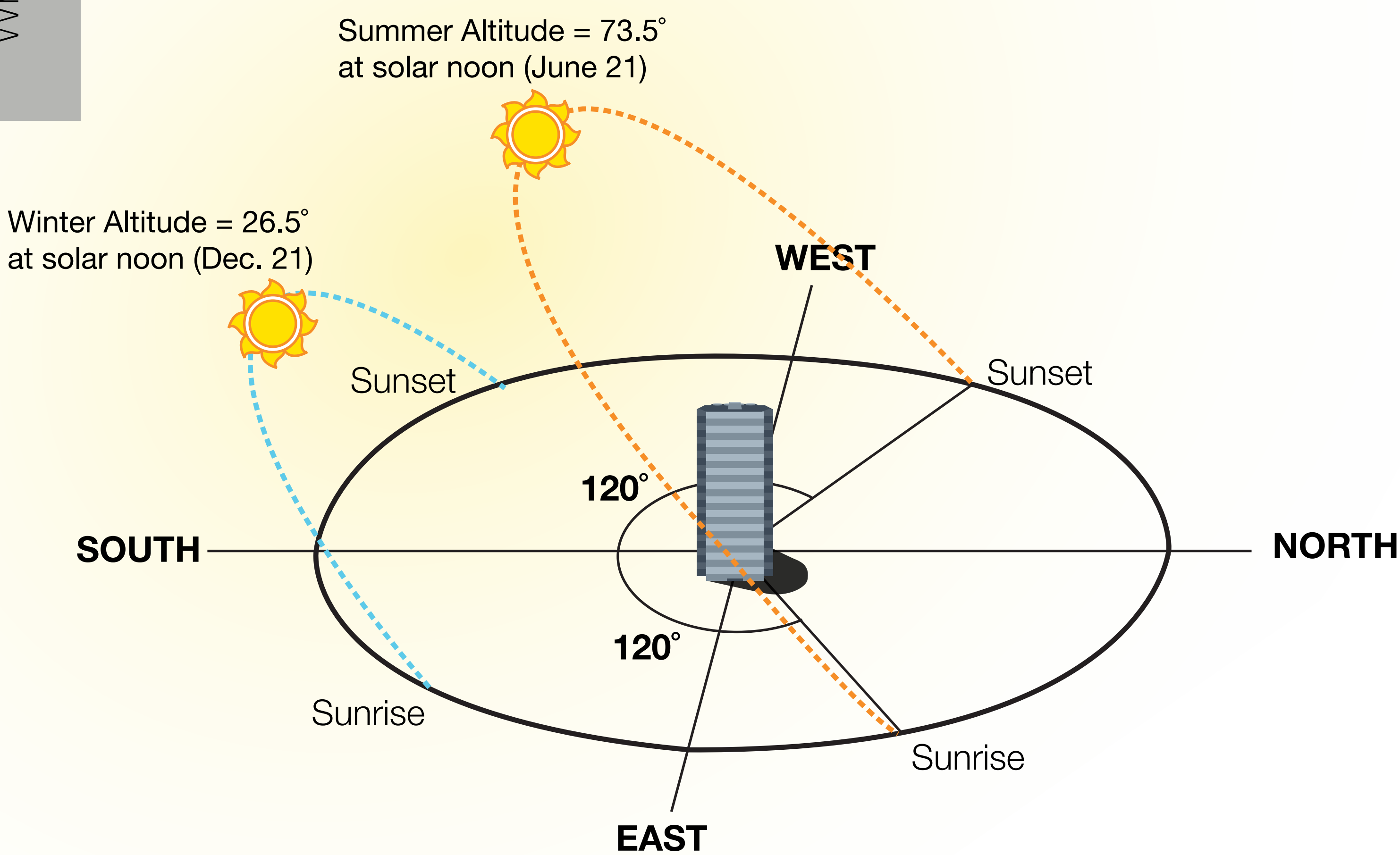
See daylight autonomy in action. Visit
www.lutron.com/daylightautonomy.

The Pantheon | Rome, Italy

What is daylight autonomy?

Daylight autonomy—The result of designing a space to maximize the amount of useful daylight, thereby minimizing or eliminating the need for supplemental electric light.

In mathematical terms, daylight autonomy is the percentage of annual work hours during which all or part of a building's lighting needs can be met through daylighting alone.

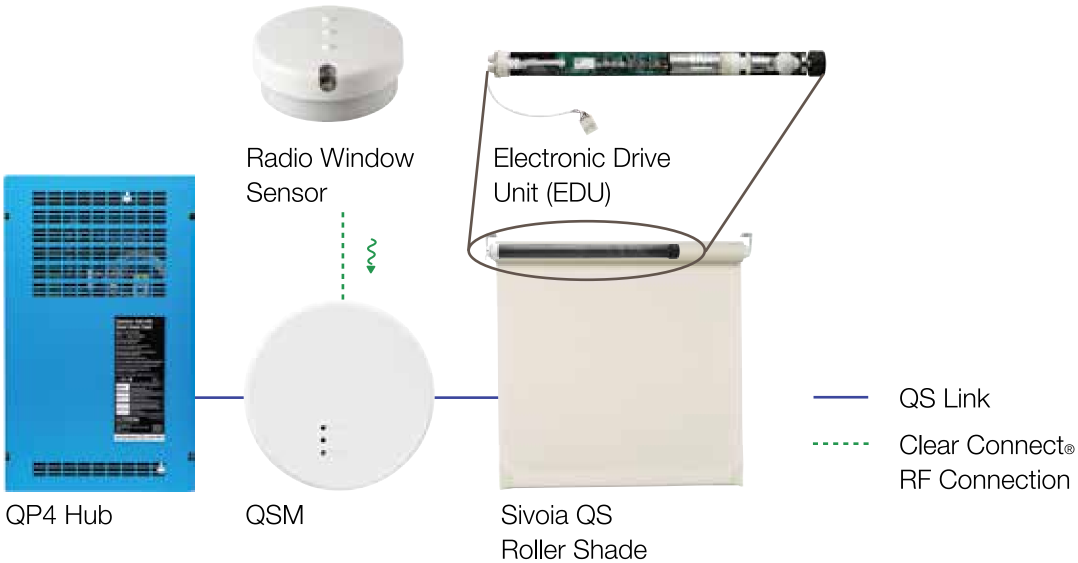


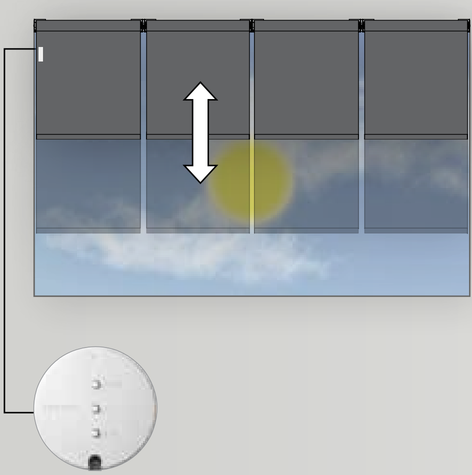
Designing for daylight autonomy involves understanding how the entire building is affected by the dynamic nature of daylight, and creating a lighting control strategy to automatically adjust to these changes.

Lutron daylight autonomy solution

Combining Lutron Sivoia® QS automated shades, Hyperion™ solar adaptive technology, Radio Window™ sensors, and Lutron daylight dimming technology provides the ideal solution for increasing energy savings while reducing glare and enhancing comfort.

Hyperion solar-adaptive shading automatically adjusts Lutron Sivoia QS roller shades throughout the day based on the position of the sun. Automated shading helps to maintain ideal light levels, and may also lower demand on a building's HVAC system.



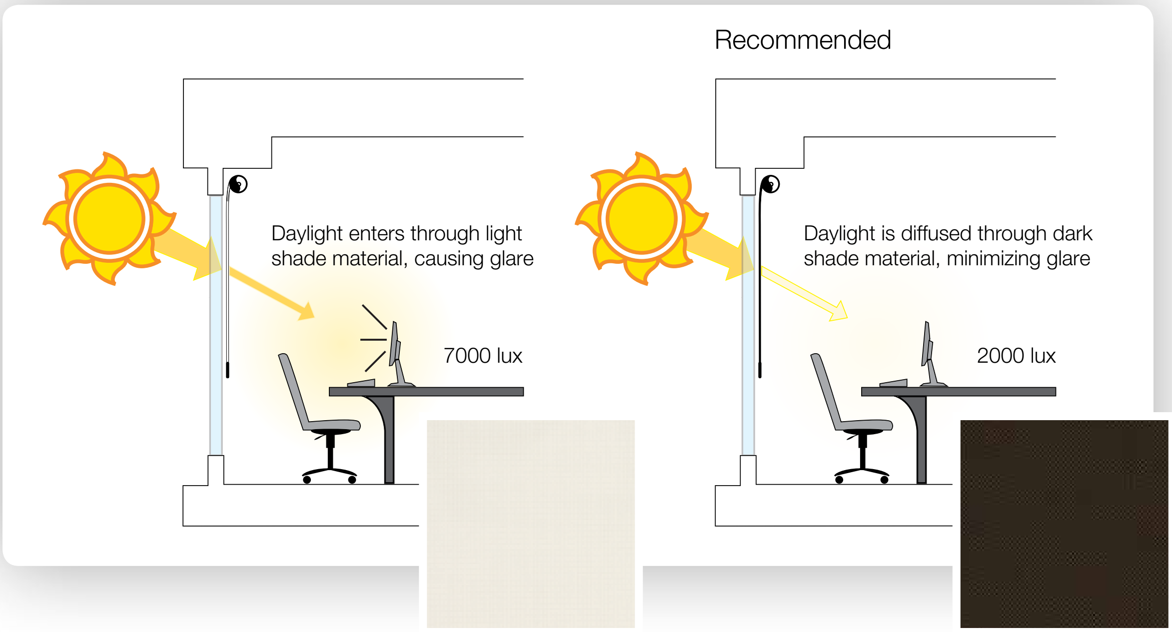


Wireless window sensor

Radio Window sensors maximize views and available daylight by overriding Hyperion to keep shades open when there are cloudy conditions, or dark shadows. They also provide brightness override and close shades to limit glare.

Glare

Fabric selection is critical to controlling daylight glare – Lutron offers a wide variety of fabric choices to meet the needs of any space. For example, fabrics with low transmittance levels (Tv value) are often recommended in spaces that receive direct sun. Low Tv value is recommended to reduce glare and maintain optimal light levels within a comfortable range (200-2000 lux).



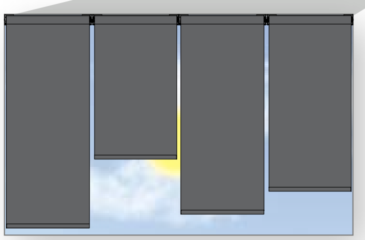
Basketweave 90
in Oyster
(Tv=0.14)

Basketweave 90
in Charcoal
(Tv=0.05)

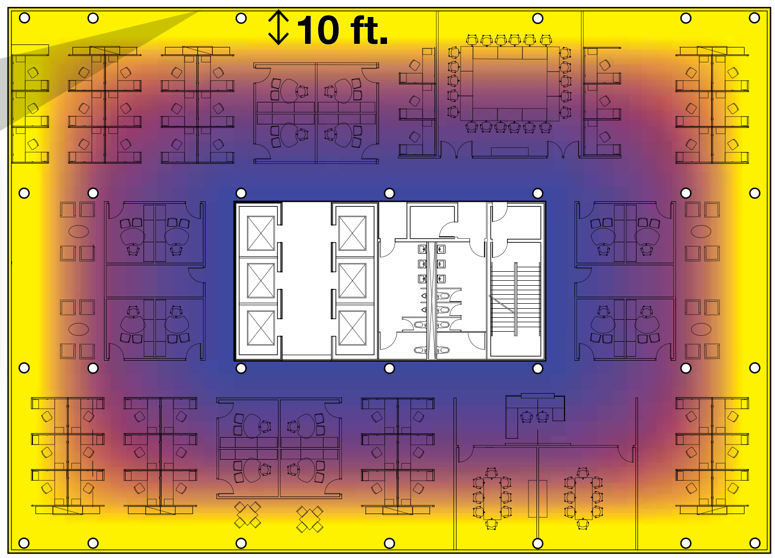
Light

Automated shades help maintain a consistent light level in any environment, and expand the useful daylight zone inside the perimeter of a space. Manual shades create a useful daylight zone of 10 feet, but automated shades can increase that zone to 20 feet.

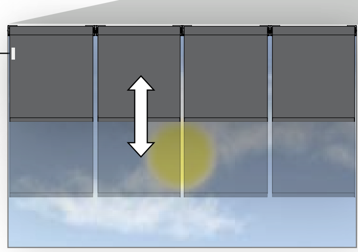
Manual shades provide a useful daylight zone up to only **10 ft.**



Manual shades are rarely adjusted and are usually misaligned, diminishing their effectiveness.

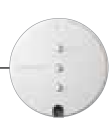


Lutron shading solutions extend the useful daylight zone up to **20 ft.**

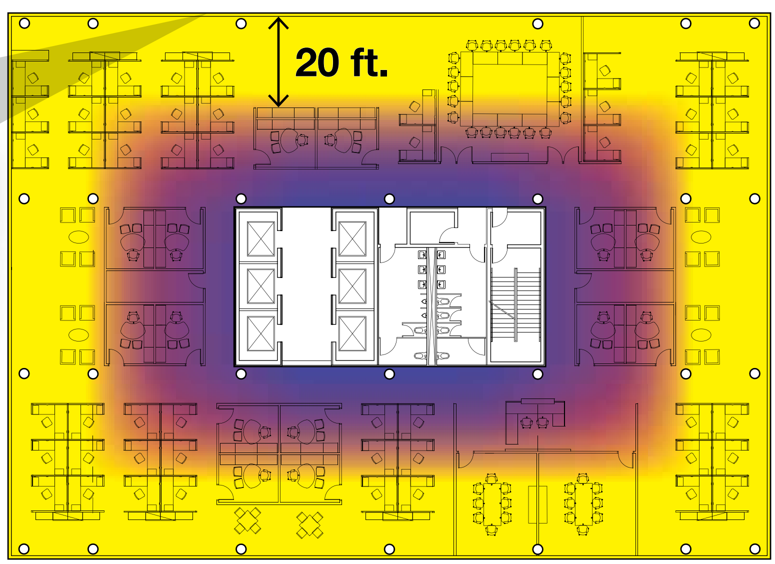


Sensor adjusts automated shades according to daylight conditions.

Maximizes useful daylight entering a space, reducing electric light usage.



Wireless window sensor (discreet mullion mount)

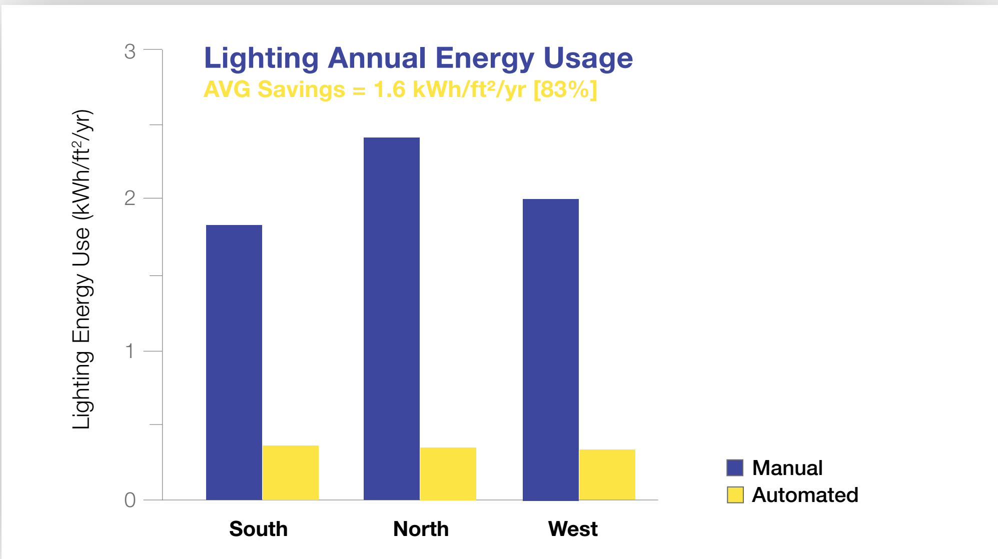


Expected energy savings from Lutron daylight autonomy strategies

Automated shading systems can make significant contributions to a building's energy efficiency, and to productivity.

Save an additional 65% lighting energy

An automated shade simulation in perimeter, private offices demonstrates that daylight-harvesting control can reduce lighting energy use by 65% or more through the use of automated shades.[1]



Access to views enhances mood, improves productivity, and increases memory function

- Glare from windows can reduce productivity by up to 20%[2]
- Access to views has been shown to:

    -Increase memory function and mental recall by up to 15%[2]

    -Improve productivity by up to 12%[2]

Lutron shading solutions minimize glare and can maintain views (with solar screen fabrics) to create a better work environment. Our shades offer seamless adjustment during the workday without any disruption to occupants in the space. The ultra-quiet, electronic drive ensures smooth operation without distraction.

Reduce daytime lighting energy use by 65%[1] or more through the use of automated shades.

Allsteel | *San Francisco, CA*

Building codes and design trends

Advanced Lutron daylight autonomy strategies help to meet or exceed increasingly stringent building codes and standards.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

The U.S. Department of Energy has mandated that as of October 18, 2013, all state, commercial building codes must meet or exceed ASHRAE 90.1-2010 standards, which include that “daylight zone requirements” are met by using mandatory requirements for daylight harvesting technology.

IECC and Title 24

These include daylighting requirements similar to ASHRAE’s in their updated recommendations.

ASHRAE 189.1-2011

This includes standards for the design of high performance green buildings, specifically:

- Chapter 7/Energy Efficiency Section 7.4.2.5 Permanent Objects
- Chapter 8/Indoor Environmental Air Quality Section 8.4.1.2 Office Space

Leadership in Energy and Environmental Design (LEED)

Daylight harvesting control can contribute toward LEED credits in several new construction categories. Daylight autonomy can also contribute to LEED points.

Lutron automated shades capitalize on your mandated investment

Challenges to daylight autonomy design

Exterior daylight is constantly changing, and that affects the indoor environment. Daylight autonomy strategies respond to changes in daylight from clouds, mature landscaping, and other environmental factors to maintain a constant light level, save energy, and minimize glare.

Maximize energy savings

As energy rates rise, energy savings become more and more important to the bottom line. Daylight reduces the need for electric light, but can also cause heat gain, which can raise HVAC costs.

Automated shades help to balance light and heat to save building energy.

Glare

Glare can cause eyestrain, headaches, and general discomfort. Vast amounts of daylight may eliminate the need for electric light during daytime hours, but create problems like decreased productivity, or increased absenteeism, costing companies money.

Automated shades invite daylight into the space, but moderate it to avoid the negative effects of glare.

Daylight autonomy strategies save lighting energy and minimize glare

Photo © Halkin Photography

Ben Franklin Technology Partners of Northeastern Pennsylvania | Lehigh Valley, PA

Metrics

Measuring the benefits of daylight autonomy

Three metrics are particularly useful for evaluating daylight autonomy design.

- spatial Daylight Autonomy (sDA)
- spatial Daylight Autonomy max (sDAmax)
- annual Sunlight Exposure (aSE)

Evaluating Quantity:
spatial Daylight Autonomy (sDA300,50%): 300 lux/50% time

- Percentage of floor space where a minimum light level (300 lux) can be met completely with daylight for 50% of work hours.
- Based on the idea that more light is better, this metric is an indicator of quantity of daylight available.
- A higher sDA yields greater autonomy from electric lighting, but does not necessarily result in a comfortable work environment.

Evaluating Quality:
spatial Daylight Autonomy max (sDAmax5000,5%): 5000 lux/5% time

- Percentage of floor space where the light level exceeds 10 times the required light level (5000 lux) for 5% of work hours.
- This metric is an indicator of quality related to all types of glare – such as direct sun, reflected sun, high ambient brightness, and overly bright sky.
- A low sDAmax indicates that the benefits of daylight autonomy are not overshadowed by glare conditions that decrease comfort and performance.

Other Metrics:
annual Sunlight Exposure (aSE1000,250): 1000 lux/250 hours

- Percentage of work hours during which the light level from direct sun alone exceeds the pre-defined threshold (1000 lux) for 250 hours.
- Relates directly to sun glare, the worst type of glare, but only measures how well passive shading devices, such as light shelves and overhangs, are performing.
- Even with passive shading devices in ideal situations, shades will usually be required to address sky and reflected sunlight glare. Automated shades are the best way to guarantee optimal daylight performance.

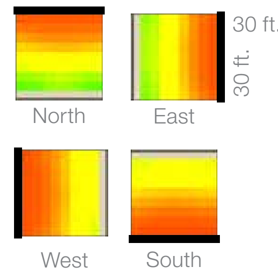
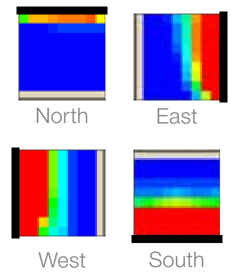
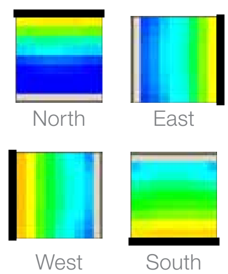
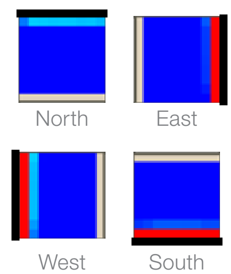
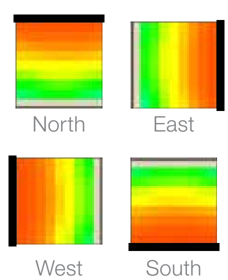
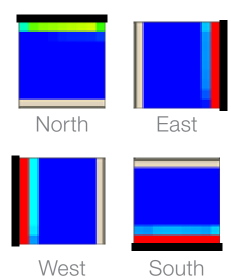
Sources

[1] Simulated savings compared to applications where shades are closed, as shades are not often moved. Both the closed and automated shade simulations assumed fabrics with a transmittance of 15% or less for glare control. Savings would be less for fabrics with higher transmittances. Requires a daylight harvesting system. Lutron Electronics Co., Inc. worked with Purdue University to analyze the benefits and savings potential of Lutron’s Hyperion automated shading systems. The results showed the impact of how automated shades significantly reduce annual lighting energy usage. Savings are based on energy simulation of a perimeter private office with a lighting power density of 0.9 W/ft², a standard clear double pane glass, and a shade fabric with 5% transmittance and a 76% reflectance. Values shown are the average of three window-to-wall ratios: 20%, 40%, and 60%. Daylight harvesting system required.

[2] Heschong Mahone Group, Inc., 2003. Windows and Offices: A study of office worker performance and the indoor environment. Prepared for California Energy Commission.

sDA and sDAmax metrics can be significantly improved with automated shading

We performed a daylighting simulation using Daysim software, to evaluate the effect of shade automation on daylight autonomy of four 30 ft x 30 ft open office bays facing north, south, east, and west.

OFFICE AXONOMETRIC	FLOOR PLANS: **Daylight Autonomy** sDA (3000, 50%)=	**Glare** sDAmax (5000, 5%)=
 No shading device	 **100%**	 **32%**
 +Manual shade/ mostly closed	 **36%**	 **8%**
 **+Automated shades (ideal)**	 **86%**	 **10%**
Goal results	**>55%**	**≤10%**

Each open office bay has a single perimeter façade with a 70% window to wall ratio facing one of the four cardinal directions (north, south, east, or west) as indicated by the North compass. The rooms were evaluated with a New York City climate, 60% transmittance glass, 10% transmittance roller shade, bright room reflectance (30% floor, 70% walls, 90% ceiling), and a workplane height of 30 inches above the floor. The automated shading system in the simulation was set up to approximate Lutron's Hyperion® shade algorithm with Shadow and Brightness overrides.

For more information on any of our commercial shading solutions, please contact your local Lutron representative. To experience the benefits our shading solutions provide, please schedule a tour at one of our Experience Centers.

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Please visit ce.architecturalrecord.com to read the article, "Daylight Autonomy 101," and take a short quiz to earn Continuing Education credits for AIA and GBCI.

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